PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
H01Q 1/24, 9/04

A1

(11) International Publication Number: WO 95/24746

(43) International Publication Date: 14 September 1995 (14.09.95)

(21) International Application Number: PCT/EP95/00813

(22) International Filing Date: 6 March 1995 (06.03.95)

(30) Priority Data:
0267/94 8 March 1994 (08.03.94) DK

(71) Applicant *(for all designated States except US)*: CETELCO CELLULAR TELEPHONE COMPANY A/S [DK/DK]; Østre Allé 6, DK-9530 Støvring (DK).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: PEDERSEN, Gert, Frølund [DK/DK]; Egense Hjørnet 25, DK-9280 Storvorde (DK). THOMSEN, Jan, Gert [DK/DK]; Østerbro 80, 3. th., DK-9000 Aalborg (DK).

(74) Agent: DRÖMER, Hans-Carsten; Preussag AG, Karl-Wiechert-Allee 4, D-30625 Hannover (DE).

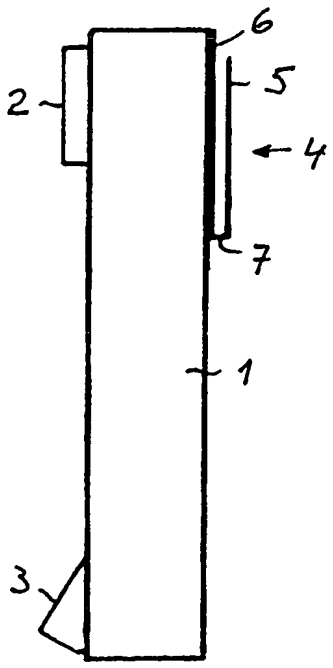
(81) Designated States: AU, CN, EE, JP, LT, LV, RU, UA, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: HAND-HELD TRANSMITTING AND/OR RECEIVING APPARATUS

(57) Abstract

A hand-held transmitting and/or receiving apparatus has an elongated housing, an electric circuit inside the housing, an earphone at one side and one end of the housing, an electric ground plane at the other side of the housing opposite to the earphone, an antenna resonator element arranged approximately parallel to the ground plane and having a first free and a second end which is electrically connected by a ground connector to the ground plane and means for connecting the ground plane and the resonator element to the electric circuit. The free end of the resonator element points to the end of the housing. By this the strength of the electrical field of the antenna near the hand or the head of the user is low. This lowers health risk and influences on the hand or the body of the user on the electric parameters of the antenna.



BNSDOCID: <WO___9524746A1_I_>

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	**GB**	United Kingdom	**MR**	Mauritania
AU	Australia	**GE**	Georgia	**MW**	Malawi
BB	Barbados	**GN**	Guinea	**NE**	Niger
BE	Belgium	**GR**	Greece	**NL**	Netherlands
BF	Burkina Faso	**HU**	Hungary	**NO**	Norway
BG	Bulgaria	**IE**	Ireland	**NZ**	New Zealand
BJ	Benin	**IT**	Italy	**PL**	Poland
BR	Brazil	**JP**	Japan	**PT**	Portugal
BY	Belarus	**KE**	Kenya	**RO**	Romania
CA	Canada	**KG**	Kyrgystan	**RU**	Russian Federation
CF	Central African Republic	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CG	Congo			**SE**	Sweden
CH	Switzerland	**KR**	Republic of Korea	**SI**	Slovenia
CI	Côte d'Ivoire	**KZ**	Kazakhstan	**SK**	Slovakia
CM	Cameroon	**LI**	Liechtenstein	**SN**	Senegal
CN	China	**LK**	Sri Lanka	**TD**	Chad
CS	Czechoslovakia	**LU**	Luxembourg	**TG**	Togo
CZ	Czech Republic	**LV**	Latvia	**TJ**	Tajikistan
DE	Germany	**MC**	Monaco	**TT**	Trinidad and Tobago
DK	Denmark	**MD**	Republic of Moldova	**UA**	Ukraine
ES	Spain	**MG**	Madagascar	**US**	United States of America
FI	Finland	**ML**	Mali	**UZ**	Uzbekistan
FR	France	**MN**	Mongolia	**VN**	Viet Nam
GA	Gabon				

BNSDOCID: <WO___9524746A1_I_>

Hand-held transmitting and/or receiving apparatus

The invention relates to a hand-held transmitting and/or receiving apparatus comprising an elongated housing, an electric circuit inside the housing, an earphone at one side and one end of the housing, an electrical ground plane at the other side of the housing opposite to the earphone, an antenna resonator element arranged approximately parallel to the ground plane and having a first free and a second end which is electrically connected by a ground connector to the ground plane and means for connecting the ground plane and the resonator element to the electrical circuit.

An apparatus of this kind is disclosed in Japanese patent application 63-86 559. The antenna is an inverted F-antenna. The antenna resonator element of this antenna is connected to the ground plane by a ground connector at the end of the housing where the earphone is positioned. Therefore the free end of the antenna points away from this end of the housing and extends to the middle of the housing where the hand of the user holds the apparatus. From this follows that the hand of the user not only influences the field of the antenna and the radiation pattern accordingly but also the resonance frequency, the impedance and the gain of the antenna. As a result of the mismatching standing waves on the feedline to the antenna appear resulting in a loss of high frequency power.

A further disadvantage of this known antenna results from the fact that the centre of the head of the user is

CONFIRMATION COPY

BNSDOCID: <WO___9524746A1_I_>

near to the maximum of the strength of the electrical field of the antenna. This results in additional losses of the radiation energy when the antenna is used as a transmitting antenna but results also in influences of the electrical field to the head of the user so loading the head with health risks.

The object of the invention is to overcome the disadvantages of the state of the art namely to avoid influences from the hand or head of a user of the hand-held transmitting and/or receiving apparatus on the antenna and vice versa.

The basic idea of the invention is to turn the known antenna by 180° so that the free end of the antenna is pointing to the end of the housing where the earphone is positioned. Therefore the maximum of the electrical field of the antenna is as far away from the user as possible, especially from his hand and his head so that the mutual influence is minimum. This means a lower influence on the electrical parameters of the antenna, especially impedance, gain and effectivity. On the other side the risks on the health of the user are minimized.

According to one embodiment of the invention the ground plane extends over approximately the whole width of the elongated housing. This assists in achieving a radiation pattern having the maximum or maxima away from the head of the user.

According to a further embodiment of the invention the resonator element has approximately the same width and radiation pattern.

To this also adds a further improvement of the basic idea of the invention according to which the ground connector extends over the whole width of the resonator element.

According to a further improvement an elongated feeder element is provided positioned at one side of the resonator

BNSDOCID: <WO___9524746A1_I_>

element for coupling the feeder element to the resonant element, one end of the feeder element representing a feeding end coupled to the means for connecting the resonator element to the electric circuit. This improvement avoids a galvanic contact between the electric circuit and the resonator element. Preferrably the feeder element extends over approximately the whole length of the resonator element. By this an electromagnetic coupling is achieved. Additionally the feeding end of the feeder element can be positioned at the free end of the resonant element.

According to one improvement of the invention a projection is provided at the edge of the free end of the resonator element the projection having a smaller width than the resonator element. By adjusting the length of the projection the resonant freqency of the resonator element can be tuned. Preferrably, the width of the projection is ten times or more less than the width of the resonator element. By this dimensioning of the projection a fine tuning of the resonator element is possible.

According to one improvement of the invention the resonator element and the ground plane are in the form of an electrically conducting layer or coating on a dielectric substrat. By this airgaps between the resonator element and the ground plane are avoided which may be influenced by mechanical forces, temperature or the like which could change the electrical parameters of the antenna. Preferrably the dielectric substrat is the housing or a part of the housing. More preferrably the dielectric substrat is a separate unit connected to or positioned inside the housing made from non-conducting material. The ground connector may comprise one single ground connector element extending over the whole width of the resonator element or may comprise at least two ground connector elements distributed over the width of the resonator element.

In the following the invention will be described in

CONFIRMATION COPY

BNSDOCID: <WO___9524746A1_I_>

more details by way of examples shown in the drawings in which

fig. 1 is an elevational view of one example of a hand-held transceiver for a wireless telephone,

fig. 2 is a view on the backside of the transceiver according to fig. 1.

fig. 3 is a section III-III through fig. 2,

fig. 4 is a view similar to fig. 3 showing a second example,

fig. 5 is a sectional view through a third example similar to the upper part of fig. 4 and

fig. 6 is a perspective view of the antenna unit in fig. 5.

Fig. 1 is a side view of a hand-held transceiver comprising a housing 1, an earphone 2, a microphone 3 and an antenna 4 consisting of an resonator element 5, a ground plane 6 and a ground connector 7 connecting one end of the resonator element 5 to the ground plane 6.

The resonator element 5, the ground connector 7 and the ground plane 6 are in the form of a metallic sheet. The ground plane 6 is connected to the backside of the housing 1.

As can be best seen from fig. 2 the width of the ground plane 6 is the same as the width of the housing 1, and the width of the resonator element 5 also has almost the same width as the housing 1. The means for feeding the resonator element 5 and for connecting it and the ground plane 6 to the circuit inside the housing 1, namely a transmitter and a receiver, are not shown and may have any form known in the state of the art. E. g., a coax-cable can be connected to the ground plane the core of the cable being connected to

CONFIRMATION COPY

BNSDOCID: <WO___9524746A1_I_>

the resonant element 5 at a distance away from the ground connector 7.

As can be best seen from fig. 1 the free end of the resonant element 5 points in the direction to the end of the housing 1 carrying the earphone 2. Therefore the strength of the electrical field generated by the resonant element 5 has its maximum away from the area where the hand of a user grips the housing 1, namely between the earphone 2 and the microphone 3. The strength of the electrical field near the ground connector 7 is low. The result is that the influence of the hand of the user on the antenna 4 is low. Furthermore the maximum of the electrical field of the antenna at its free end is as far away from the head of the user as possible when the earphone 2 contacts the ear of the user.

Fig. 3 shows another example in cross section almost similar to a section III-III through fig. 2. Similar items have the same reference numbers. Different from the example shown in figures 1 and 2 is the positioning of the ground plane 6 which now is inside the housing 1 while the resonant element 5 is outside of the housing 1 the ground connector extending through a slit in the wall of the housing 1. Ground plane 6 and resonator element 5 are in the form of conducting layers on the wall of the housing 1 which wall is made from a dielectric material. Since there is no air gap between the resonant element 5 and the ground plane 6 on the one hand and the dielectric material of the wall of the housing 1 on the other hand the electric parameters of the antenna are highly independent from mechanical forces on the antenna 5 and/or the groundplane 6.

Fig. 4 shows an example in a form similar to fig. 3. Similar items carry the same reference number. In fig. 4 the antenna element 5, the ground plane 6 and the ground connector 7 are conducting layers on a separate dielectric substrate 8 altogether forming an independent unit which is fixed to the inner wall of the housing 1. This avoids a slit

CONFIRMATION COPY

BNSDOCID: <WO__9524746A1_I_>

through the wall of the housing 1 for the ground connector 7 connecting the foot of the resonator element 5 to the ground plane 6. Since all electric elements of the antenna in this example are inside the housing 1 it is easier to connect the electric elements of the antenna to the electric circuit inside the housing 1.

Fig. 5 shows in more details a sectional view through the upper part of a hand-held apparatus with an antenna arrangement similar to that of fig. 4. Inside a wall 9 of a housing 10 most of which is broken away an antenna unit 11 is positioned consisting of a dielectric body 12 on which in form of electric layers an antenna resonator element 13, a ground connector 14 and a ground plane 15 are fixed. The ground plane 15 has protrusions 16 and 17 contacting a conducting elastic layer 18 on a circuit board 19 carrying the electrical leads and elements not shown in known manner.

The dielectric body 12 has a recess 20 so providing a cavity 21 into which circuit elements on the circuit board 19 may extend which are so well-screened by the electric layer of the ground plane 15.

Fig. 6 shows the unit comprising the dielectric body 12, the resonant element 13, the ground connector 14 and the ground plane 15 in perspective view. It can be seen that from an edge 22 of the free end of the resonant element 13 a projection 23 extends the width of which is much smaller than the width of the resonant element 13. The projection 23 can be shortened for tuning purposes.

In fig. 6 furthermore can be seen that at one side of the resonant element 13 a feeder element 24 is fixed on the surface of the dielectric body 12, said feeder element 24 extending approximately over the whole length of the resonator element 13. The free end of the feeder element 24 is near the ground connector 14 while another end 25 of the feeder element 24 extends to that side of the dielectric body 12 where the ground plane 15 is located. Therefore the

CONFIRMATION COPY

BNSDOCID: <WO___9524746A1_I_>

feeder element 24 can be connected to the electric leads of the circuit board 19 by a small conducting and elastic layer just in the same manner as the ground plane 15 is connected to the circuit board 19 by the layer 17.

CONFIRMATION COPY

BNSDOCID: <WO___9524746A1_I_>

C l a i m s

1. Hand-held transmitting and/or receiving apparatus, comprising

- an elongated housing
- an electric circuit inside the housing
- an earphone at one side and one end of the housing
- an electrical ground plane at the other side of the housing opposite to the earphone
- an antenna resonator element arranged approximately parallel to the ground plane and having a first free end and a second end which is electrically connected by a ground connector to the ground plane and
- means for connecting the ground plane and the resonator element to the electric circuit,

characterized in that the free end of the resonator element (5) points to the one end of the housing (1).

BNSDOCID: <WO___9524746A1_I_>

2. Apparatus according to claim 1, characterized in that the ground plane (6) extends over approximately the whole width of the elongated housing (1).

3. Apparatus according to claim 1, characterized in that the resonator element (5) has approximately the same width as the ground plane (6).

4. Apparatus according to claim 1, characterized in that the ground connector (7) extends over at least the half width of the resonator element (5).

5. Apparatus according to claim 1, characterized in that an elongated feeder element (24) is positioned at one side of the resonator element (13) for coupling the feeder element (24) to the resonator element (13), one end (25) of the feeder element (24) representing a feeding end being coupled to the means for connecting the resonator element (13) to the electric circuit.

6. Apparatus according to claim 5, characterized in that the feeder element (24) extends over approximately the whole length of the resonator element (13).

7. Apparatus according to claim 5, characterized in that the feeding end of the feeder element (24) is positioned at the free end of the resonant element (13).

8. Apparatus according to claim 1, characterized in that a projection (23) is provided at the edge (22) of the free end of the resonator element (13) the projection (23) having a smaller width than the resonator element (13).

9. Apparatus according to claim 8, characterized in that the width of the projection (23) is ten times or more less than the width of the resonator element (13).

CONFIRMATION COPY

BNSDOCID: <WO___9524746A1_I_>

10. Apparatus according to one of the foregoing claims, characterized in that the resonator element (13) and the ground plane (15) are in the form of an electrically conducting layer or coating on a dielectric substrate.

11. Apparatus according to claim 10, characterized in that the dielectric substrate is the housing or a part of the housing.

12. Apparatus according to claim 10, characterized in that the dielectric substrate is a separate body (12) connected to or positioned inside the housing (1) made from non-conducting material.

13. Apparatus according to claim 1, characterized in that the ground connector comprises at least two separate ground connector elements distributed over the width of the resonator element.

CONFIRMATION COPY

BNSDOCID: <WO___9524746A1_I_>

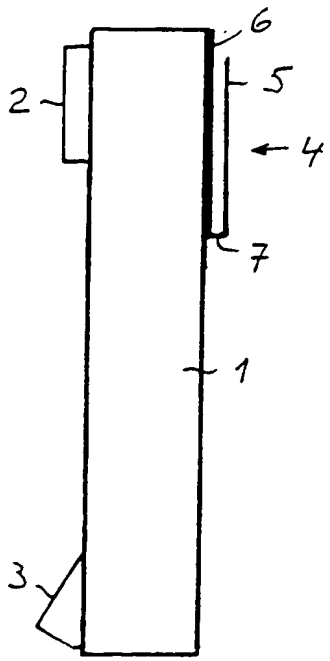


FIG. 1

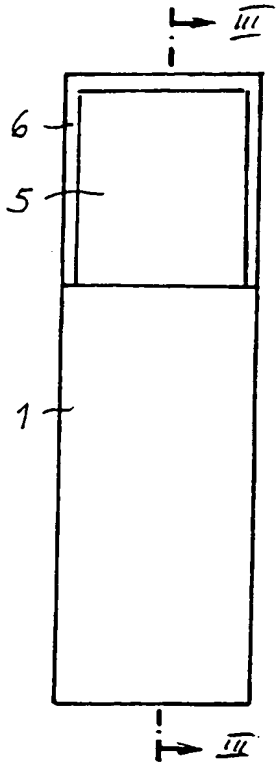


FIG. 2

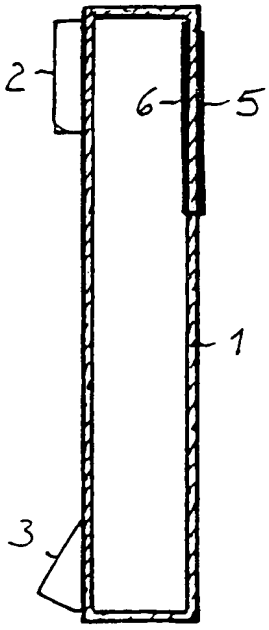


FIG. 3

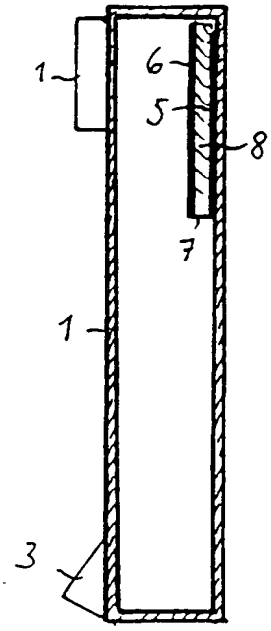


FIG. 4

CONFIRMATION COPY

BNSDOCID: <WO___9524746A1_I_>

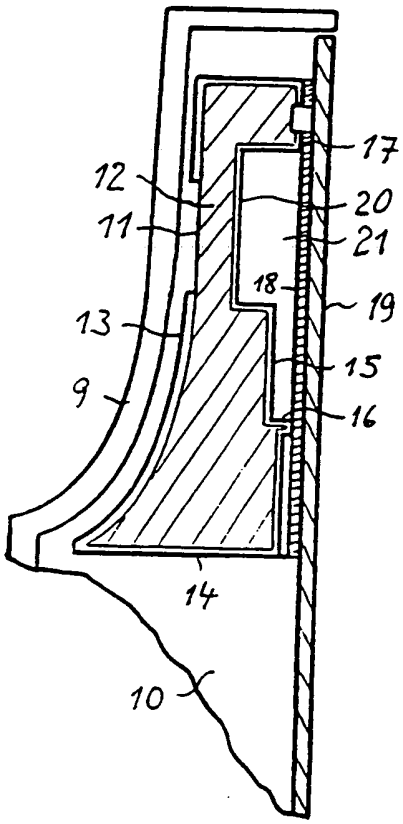


FIG. 5

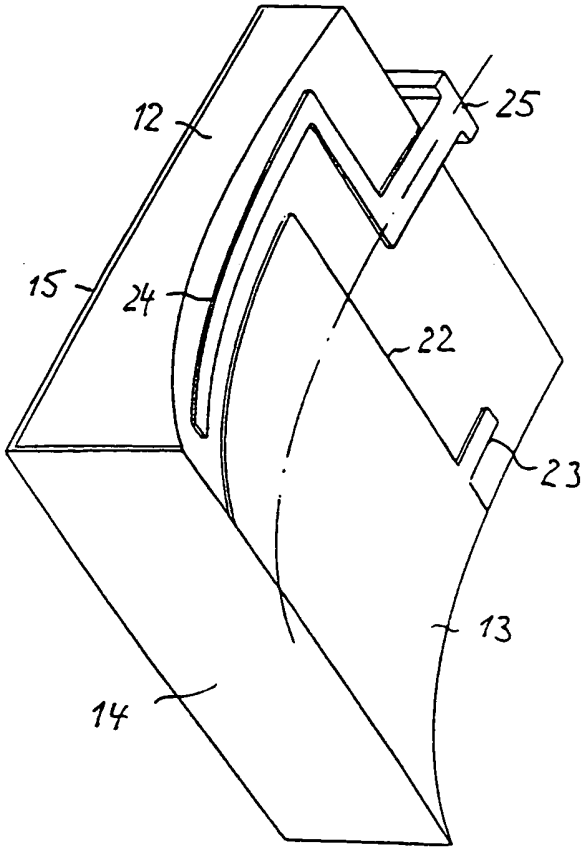


FIG. 6

CONFIRMATION COPY

BNSDOCID: <WO___9524746A1_I_>

INTERNATIONAL SEARCH REPORT

International Application No
[redacted]EP 95/00813

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H01Q1/24 H01Q9/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H01Q H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	WO,A,94 24723 (WIRELESS ACCESS) 27 October 1994 see page 24, line 15 - page 25, line 8 see page 27; figures 1,4A-C,6	1
A	WO,A,90 13152 (NOVATEL COMMUNICATIONS) 1 November 1990 see claims 1-26; figures 1-3	1-13
A	GB,A,2 238 665 (KOKUSAI DENSHIN DENWA) 5 June 1991 see abstract; figures 1-3B	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 June 1995	06.07.95

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Angrabeit, F

Form PCT/ISA/210 (second sheet) (July 1992)

BNSDOCID: <WO___9524746A1_I_>

INTERNATIONAL SEARCH REPORT

mation on patent family members

ional Application No
CT/EP 95/00813

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO-A-9424723	27-10-94	AU-B-	6637194	08-11-94
		JP-A-	6314923	08-11-94
WO-A-9013152	01-11-90	AU-A-	5435190	16-11-90
		CA-A-	2014629	18-10-90
		US-A-	5231407	27-07-93
GB-A-2238665	05-06-91	JP-A-	3166803	18-07-91
		CA-A-	2030886	28-05-91
		US-A-	5173711	22-12-92

BNSDOCID: <WO___9524746A1_I_>